American Anthropologist

NEW SERIES

VOL. 9 JULY–SEPTEMBER, 1907 NO. 3

HEREDITY IN ANTHROPOMETRIC TRAITS

By FRANZ BOAS

A number of years ago I published the results of a study of heredity in head form which was based on material that Dr Maurice Fishberg had the great kindness to collect for me among the Russian Jews of New York City.[1] The results seemed sufficiently interesting to justify a continuation of the work. This has been made possible by a grant from the Esther Herrman Fund of the Scientific Alliance of New York. While my first report was based on observations on 48 families, I have been able, through the kind assistance of Dr Fishberg and Mr Joseph Fish, to collect data relating to 192 families. The extended calculations were made by Dr A. B. Lewis.

All the families from which measurements were collected were East European Jews, and almost all of them Russian Jews. I have confined myself to gathering measurements of length and width of head. Only in the first series of 48 families was the width of face also observed. The principal question that I have had to investigate is, whether there is a tendency in offspring to group themselves around the middle value of the parents (Galton's midparent), or whether they rather tend to revert to either the paternal or the maternal type. I have shown in a previous paper that in regard to some head measurements the latter tendency is found in the mixture of American Indian and of White blood,[2] and the preliminary investigation tended to show that in the intraracial marriages of Russian Jews the same tendency prevailed. It seemed, however, necessary to base this conclusion on more extensive material.

[1] Heredity in Head Form, *American Anthropologist*, N. S., 1903, V, pp. 530–538.

[2] *Verhandlungen der Berliner anthropologischen Gesellschaft*, 1895, pp. 406–409; *Popular Science Monthly*, October, 1894, pp. 761–770.

The series at my disposal has been measured partly by Dr Fishberg (I), partly by Mr Fish (II), partly — for the sake of obtaining uniformity — by the two observers jointly (III). It seems, therefore, necessary to show in how far the three series are comparable. The following table gives the results of these comparisons :

	Males, 21 years and more			*Females, 19 years and more*		
	LENGTH OF HEAD					
Series	Average	Variability	No. of Cases	Average	Variability	No. of Cases
I	188.7	± 6.4	57	181.9	± 6.2	54
II	189.2	± 5.7	82	182.6	± 6.1	84
III	188.6	± 6.0	80	180.5	± 4.5	79
Total	188.9	± 6.0	219	181.7	± 5.7	217
	WIDTH OF HEAD					
I	153.0	± 5.3	57	150.1	± 5.0	54
II	155.5	± 4.7	82	149.8	± 5.5	84
III	154.4	± 4.7	80	150.3	± 4.7	79
Total	154.5	± 5.0	219	150.0	± 5.1	217
	CEPHALIC INDEX					
I	81.3	± 3.0	57	82.6	± 3.2	54
II	82.2	± 2.5	82	82.0	± 3.3	84
III	82.0	± 3.5	80	83.3	± 2.6	79
Total	81.9	± 3.1	219	82.7	± 3.1	217

It will be seen that none of these results shows individual differences that are not adequately explained by accidental variation of the group investigated.

I have examined the same question by having the calculation made of the correlation of length and width of head in individuals, and of correlation of cephalic index of parents and children and of brothers and sisters. The following table gives the results of this calculation :

Index of Correlation of Length and Width of Head

	Males, 21 years and more			*Females, 19 years and more*		
Series	r	Error	n	r	Error	n
I	0.40	± 0.10	57	0.36	± 0.12	54
II	0.52	± 0.08	82	0.37	± 0.10	84
III	0.03	± 0 11	80	0.45	± 0.09	79
Total	0.31	± 0.06	219	0.39	± 0.06	217

Index of Correlation of Cephalic Index of

	Fathers and Children			*Mothers and Children*			*Brothers and Sisters*		
Series	r	Error	n	r	Error	n	r	Error	n
I	0.29	± 0.07	158	0.27	± 0.06	158	0.23	± 0.06	157
II	0.19	± 0.06	266	0.16	± 0.06	266	0.46	± 0.05	258
III	0.15	± 0.07	201	0.34	± 0.07	209	0.50	± 0.05	199
Total	0.20	± 0.04	625	0.25	± 0.04	633	0.42	± 0.03	614

On the whole the differences of these values do not exceed chance deviations. There might be some doubt regarding the correlation of length and width of head of males in series III, but the peculiar anomaly that occurs in this case does not recur in other measurements of the same kind.

In order to make sure that preconceived notions of the observers had no effect upon the results, I had all the head measurements reduced to adult values. Since the total amount of growth of the diameter of the head after the first few years of life is slight, it seemed justifiable to make this reduction, for which I have utilized the averages given by G. M. West.[1]

Index of Correlation of Length of Head of

	Fathers and Sons		*Fathers and Daughters*		*Mothers and Sons*		*Mothers and Daughters*	
Series	r	n	r	n	r	n	r	n
I	0.10	80	0.06	53	—0.01	80	0.53	53
II	0.33	98	0.54	113	0.37	98	0.39	113
III	0.27	91	0.23	82	0.20	95	0.52	86
Total	0.24	269	0.34	248	0.20	273	0.46	252

Index of Correlation of Width of Head of

	Fathers and Sons		*Fathers and Daughters*		*Mothers and Sons*		*Mothers and Daughters*	
Series	r	n	r	n	r	n	r	n
I	0.32	80	0.31	53	0.50	80	0.22	53
II	0.30	98	0.18	113	0.40	98	0.24	113
III	0.01	91	0.24	82	0.12	95	0.33	86
Total	0.21	269	0.23	248	0.33	273	0.27	252

The average of the index of correlation for length of head of parents and children is 0.31, for width of head of parents and children 0.26; values comparable to those found for the cephalic index. The differences of the individual values seem rather large, but they are distributed quite irregularly.

These values may also be compared with the correlations obtained from the measurements of 150 pairs of brothers and sisters measured in the public schools of Worcester, Mass.[2] The deviations

[1] Antropometrische Untersuchungen über die Schulkinder in Worcester, Mass., *Archiv für Anthropologie*, 1893, XXII, 13–18.

[2] Franz Boas and Clark Wissler: Statistics of Growth, *Report of the U. S. Commissioner of Education for 1904*, Washington, 1905, pp. 125–128.

of stature and weight were determined as multiples of standard deviations. This made it possible to compare children of different ages.

Index of Correlation of Brothers and Sisters

	Worcester, Mass.	*Russian Jews*
Stature	0.42	—
Weight	0.31	—
Length of Head	0.54	0.37
Width of Head	0.55	0.36
Cephalic Index[1]	0.50	0.42

All these indices are somewhat smaller for the Russian Jews than for the children in Worcester. If these differences are significant they must not necessarily be explained by greater errors in the series of Jews, but they may perhaps be due to the greater dishomogeneity of the Worcester material. Provided a considerable number of distinct types are represented in this series, brothers and sisters of each type would be more likely to differ in the same direction from the general average than in a homogeneous series. For correlations in each individual the Worcester series of 300 individuals, constituting all the brothers and sisters, gives

for stature and length of head	0.42
for stature and width of head	0.21
for length and width of head	0.25

For the last of these values the Russian Jews give a coëfficient of 0.35, a value that seems rather high, but which is quite in accord with the uniformity of the series.

It seems remarkable that in the series of Worcester children the correlation of stature is as great as that obtained by Galton in his series of adult brothers and sisters.

The general traits of the series of Russian Jews are contained in the table on next page.

In discussing the occurrence or nonoccurrence of alternating heredity, the same method must be followed which I developed in my previous paper, but a few additions to the theory seem desirable. In my former communication I calculated the variability of the children in each family. It seems possible to determine this value with greater accuracy than I had done before If the deviation of

[1] Average: 79.3 ± 3.3

	Length of Head				*Width of Head*			
	Male		*Female*		*Male*		*Female*	
Age	mm	n	mm	n	mm	n	mm	n
1	158.3	3	——		128.6	3	——	
2	164.6	13	161.8	14	140.1	13	135.4	14
3	168.6	16	164.1	21	140.2	16	135.0	21
4	169.9	19	168.1	18	142.8	19	141.8	18
5	171.2	24	168.2	14	143.6	24	141.0	14
6	172.0	26	168.5	26	144.1	26	143.0	26
7	170.8	22	170.3	22	145.5	22	142.1	22
8	174.4	18	172.4	26	145.2	18	143.2	26
9	176.5	15	169.9	19	145.5	15	144.5	19
10	179.5	18	174.2	19	147.4	18	145.3	19
11	177.1	22	175.4	11	146.5	22	144.6	11
12	178.3	18	176.5	21	148.4	19	146.4	21
13	178.7	20	179.8	12	150.0	20	147.8	12
14	182.3	9	178.7	17	149.2	11	147.0	17
15	182.3	9	178.9	7	149.3	9	148.6	7
16	185.0	14	177.2	10	152.0	14	150.2	10
17	186.9	11	177.7	9	153.1	11	148.3	9
18	190.4	5	182.7	13	153.6	5	148.9	13
19	186.6	9	181.7	217	156.7	9	150.0	217
20	190.1	7			155.3	7		
21+	188.9	219			154.5	219		

The cephalic index decreases slightly with age:

Age	*Males*	*Females*
1–4	83.6	83.6
5–9	83.8	84.0
10–14	83.1	82.7
15–19	82.6	83.4
20 +	81.9	82.7

any particular child from the general average of children be called x, the deviations of the children of a family of n children $x_1, x_2, \cdots x_n$; the coëfficient of correlation between children of the same family r_c; and the variability of children of a family around their mean s_n^2:

$$s_n^2 = \frac{1}{n}\Sigma\left(x - \frac{\Sigma x}{n}\right)^2 = \frac{1}{n}\left\{\Sigma x^2 - \left(\frac{\Sigma x}{n}\right)^2\right\} = \frac{(n-1)\Sigma x^2 - \Sigma x_p x_q}{n^2}.$$

On the average, the variability of a family of n children will be, therefore, if σ designates the standard variability of the whole series,

$$[s_n^2] = \sigma^2\frac{n(n-1) - n(n-1)r_c}{n^2} = \sigma^2(1 - r_c)\frac{n-1}{n}.$$

It seems also desirable to determine the coëfficient of correlation of children of each family of n children, each family being taken as a separate unit.

The product P of the deviations of brothers and sisters of the same family,

$$P_n = \frac{1}{n(n-1)}\Sigma\left(x_p - \frac{\Sigma x}{n}\right)\left(x_q - \frac{\Sigma x}{n}\right)$$

$$= \frac{1}{n(n-1)}\left\{\Sigma x_p x_q - n(n-1)\left(\frac{\Sigma x}{n}\right)^2\right\}$$

$$= -\frac{1}{n-1}\,\frac{(n-1)\Sigma x^2 - \Sigma x_p x_q}{n^2} = -\frac{1}{n-1}s_n^2.$$

It follows that the coëfficient of correlation of children of families of n children, each family treated as a unit, will be

$$r_n = \frac{P_n}{s_n^2} = -\frac{1}{n-1}$$

Provided the parents show no difference among themselves, so that the separate influence of father and mother may be neglected, the value $[s_n^2]$ represents the variability of the children of a family with n children. For the series of observations on the cephalic index $\sigma^2 = 9.61$, $r_c = 0.42$, and the average number of children observed in each family is about 3.5 ; therefore

$$\sigma^2(1 - r_c)\frac{n-1}{n} = 3.9.$$

Observations of the variability for 86 children whose parents differ in regard to their cephalic index by less than 1% gives

$$\sigma^2 = 3.8,$$

a very satisfactory agreement with the theoretical value.

When we take into consideration the influence of father and mother, it can easily be shown that, according to the theory that the children vary around the midparental value, no influence upon the variability of one family should be exerted by the amount of difference of the parents. If the deviations of the parents are called x and y, each child's deviation may be represented by

$$z = r_{pc}(x + y) + \xi,$$

and each difference from the average of all the children of the family

$$z_1 - \frac{z_1 + z_2 + \cdots + z_n}{n} = \xi - \frac{\xi_1 + \xi_2 + \cdots + \xi_n}{n},$$

so that the values x and y disappear. Hence, according to this theory the variability of children of one family measured from the family average will not be influenced by the difference of the parents.

If we assume that one half of the children resemble the father, one-half the mother, the former group will be represented by the type

$$r'_{pc}x + \xi - \frac{\frac{n}{2}r'_{pc}x + \Sigma\xi + \frac{n}{2}r'_{pc}y + \Sigma\eta}{n} = r'_{pc}\frac{x-y}{2} + \xi - \frac{\Sigma(\xi+\eta)}{n};$$

and in the same way the latter group will be represented by the value

$$-r'_{pc}\frac{x-y}{2} + \eta - \frac{\Sigma(\xi+\eta)}{n}.$$

The mean square variability of this value will therefore increase for increasing values of $(x-y)$ by the amounts

$$r'^{2}_{pc}\frac{(x-y)^2}{4}.$$

It has been shown in my previous paper [1] that

$$r'_{pc} = 2r_{pc}.$$

In our series $r_{pc} = 0.22$. Thus a series of theoretical values for the variabilities of children can be calculated. The following table gives the variabilities according to observations and according to theory:

Difference of Parents, $x-y$	*Cases*	*Observed Variability*	*Theoretical Variability*
0.0 — 0.9	86	3.80	3.8
1.0 — 1.9	141	3.38	3.9
2.0 — 2.9	79	5.11	4.1
3.0 — 3.9	90	3.30	4.4
4.0 — 4.9	71	4.20	4.8
5.0 — 5.9	43	3.81	5.3
6.0 — 6.9	28	4.54	5.9
7.0 — 7.9	15	6.26	6.4
8.0 — 8.9	32	8.45	7.4
>9.0	21	16.86	9.2

[1] Loc. cit. 2, 2*, 2**, p. 534.

Unfortunately the number of observations for the greater differences being very few, no great accuracy for these variabilities can be expected. Still, the very rapid increase with increasing differences is obvious, so that it appears that the assumption of a midparental type is not tenable. Apparently the increase in variability is first slighter, then greater, than our theory demands; but the numerical values are too uncertain to allow a further theoretical discussion that might account for the characteristics of these values. It may, however, be pointed out that with the increase of differences of parents, the frequency of considerable differences in the measurements of the grandparents must materially increase. Hence, in case the same alternative inheritance of grandparental traits exists, the variability of the offspring of parents differing in type will be further increased.

It seemed desirable to test these results by a different arrangement of the material which will bring other individuals and families near the extreme end of the series. This may be done by considering only the effect of the deviation of a single parent from the average.

If we consider, as before, each child as correlated to its parents, we have

$$z = r_{pc}(x + y) + \xi,$$

and [1]

$$[z^2] = r_{pc}^2[(x + y)^2] + \sigma^2(1 - 2r_{pc}^2).$$

For a constant value of x and variable values of y, this variability assumed the value

$$[z_x^2] = r_{pc}^2(x^2 + \sigma^2) + \sigma^2(1 - 2r_{pc}^2) = r_{pc}^2 x^2 + \sigma^2(1 - r_{pc}^2).$$

If, on the other hand, we assume the case of alternating inheritance, we have

$$[z'^2] = \tfrac{1}{2}(r'_{pc}x + \xi)^2 + \tfrac{1}{2}(r'_{pc}y + \eta)^2 = \tfrac{1}{2}r'^2_{pc}(x^2 + y^2) + \sigma^2(1 - r'^2_{pc}),$$

and for a constant value of x and variable values of y

$$[z_x^2] = \tfrac{1}{2}r'^2_{pc}(x^2 + \sigma^2) + \sigma^2(1 - r'^2_{pc}) = \tfrac{1}{2}r'^2_{pc}x^2 + \sigma^2(1 - \tfrac{1}{2}r'^2_{pc});$$

and, since

$$r'_{pc} = 2r_{pc}, \quad [z_z^2] = 2r_{pc}^2 x^2 + \sigma^2(1 - 2r_{pc}^2).$$

[1] Loc. cit. 7*, p. 536.

Applying these two formulas, we obtain the following observed and theoretical results for variabilities of children of families in which one parent has a definite deviation from the general average:

Deviation of One of Parents from Average	*Number of Cases*	*Variability*		
		Observation	*Theory*	
			Midparent	*Alternating Inheritance* ($r=0.4$)
0.0—0.9	335	9.2	9.1	6.5
1.0—1.9	232	11.4	9.2	7.1
2.0—2.9	225	11.2	9.4	8.5
3.0—3.9	131	8.1	9.7	10.5
4.0—4.9	149	10.9	10.1	13.1
5.0—5.9	77	17.1	10.6	16.5
6.0—6.9	33	15.5	11.2	20.5
7.0 and more	32	24.6	11.9	26.2

Neither of these theories gives satisfactory results. For slight differences the midparental theory gives the better results, for great differences the alternating inheritance gives the better values. No change in the value of r can make the theoretical values increase with sufficient rapidity to give satisfactory results for great differences. On the other hand the theoretical values obtained for alternating inheritance are too small, when the differences of the parents from the average are small. Provided we assume that there is also a tendency of reversion to ancestral types more remote than the parents, this difficulty may be overcome. In the extreme case of some individuals reverting to the racial type as represented by the whole ancestral series, their presence will increase the variabilities for those families in which one parent is near the average, while in those in which one parent is remote from the average, the variability will be decreased.

Our series justifies, therefore, the conclusion that the cephalic index shows alternating inheritance, largely reversion to the type of father and mother, but also to more remote ancestral types.

It is important to note that this alternating inheritance appears much less distinctly, if at all, in the absolute measurement of length and width of head. Both have been tabulated in the same way as the cephalic index.

Difference of Parents	*Number of Cases*	*Length of Head* [x^2]	*Number of Cases*	*Width of Head* [x^2]
0	26	14.2	24	17.9
1	38	9.3	41	5.0
2	21	18.3	60	6.9
3	58	14.6	31	14.5
4	48	14.7	56	10.0
5	33	10.0	37	14.7
6	19	17.0	46	11.6
7	57	17.4	29	11.4
8	24	42.7	18	8.6
9	14	33.5	34	16.0
10	27	14.5	33	11.9
11	18	17.7	18	8.0
12	18	6.2	14	12 8
13	19	12.4	17	15.5
14	12	14.8	19	5.0
15	18	7.6		
16–21	26	22.9		

It will be seen that these differences are so irregularly distributed that they may very well be considered as representing the same average.

When we group the same material in such a manner that we select families with one parent having a certain deviation, the number of cases becomes somewhat larger, and we find:

Deviation of One of Parents from Average	LENGTH OF HEAD				WIDTH OF HEAD			
		Variability				Variability		
	Number of Cases	Observation	Midparent	Alternating Inheritance	Number of Cases	Observation	Midparent	Alternating Inheritance
0 and 1	216	35.1	34.0	31.8	243	22.1	23.5	22.1
2 " 3	274	27.1	34.5	32.8	217	20.2	24.0	23.1
4 " 5	149	35.6	35.6	34.8	218	21.2	25.0	25.1
6 " 7	110	38.1	37.0	37.8	154	24.5	26.0	28.0
8 " 9	90	39.0	39.0	40.5	67	30.9	28.5	31.8
10 " 11	57	33.4	41.0	46.1	55	44.1	30.5	36.4
12 " more	58	50.5	45.0	54.1				

It is hardly possible to say in this case which theory gives the better fit. For width of head the midparental theory seems to give too slight an increase of variability. More material is required to solve this problem. In the case of stature it has been found that in mixed types the stature does not revert to the parental types.[1]

The following tables contain the material on which the preceding discussion is based.

[1] *Verhandlungen der Berliner anthropologischen Gesellschaft*, 1895, pp. 381–386.

I[1]

		Age	L	W	F
1	F	40	189	157	134
	M	38	179	158	142
	D	14	184	154	129
	D	12	173	146	118
	S	10	181	160	128
	D	8	169	145	117
2	F	57	190	148	131
	M	48	162	145	119
	S	20	199	154	136
	D	17	166	145	120
	D	14	176	141	108
	S	9	179	141	112
	S	7	175	145	113
	S	5	174	146	110
3	F	27	176	153	136
	M	24	183	157	130
	S	6	169	146	98
	D	4	170	145	102
4	F	38	184	150	143
	M	28	185	150	130
	S	11	183	152	137
	D	9	172	146	114
	S	6	177	145	108
5	F	49	185	153	147
	M	48	182	146	131
	S	19	178	153	136
	S	17	189	153	138
	D	12	178	144	126
	D	8	177	145	114
6	F	28	183	151	139
	M	25	179	150	132
	S	6	168	145	124
	D	3	169	144	102
7	F	63	192	157	124
	M	60	179	154	132
	S	21	193	155	130
	D	29	196	156	135
	S	27	192	160	135
8	F	38	187	152	130
	M	39	193	155	135
	S	16	190	155	136
	D	14	182	153	125
	D	11	183	156	109
9	F	34	192	161	148
	M	31	192	145	133
	S	13	174	151	129
	S	11	180	143	122
	D	8	167	145	118
10	F	42	203	158	141
	M	39	186	152	134
	S	18	192	155	135
	S	16	181	152	136
	D	14	182	149	131
	D	10	169	146	128
	S	5	169	147	110
11	F	39	196	146	138
	M	38	181	156	141
	S	17	166	145	139
	D	15	181	141	129
	D	12	166	142	139
	S	8	187	143	129
12	F	33	186	150	142
	M	32	191	156	144
	D	15	183	147	130
	S	11	184	151	136
13	F	68	185	153	138
	M	65	181	147	129
	S	28	187	151	140
	S	23	186	147	136
	D	19	183	144	131
14	F	29	184	147	135
	M	28	194	151	131
	D	8	190	140	118
	D	6	176	141	115
	S	4	171	138	110
15	F	63	179	154	136
	M	53	185	141	116
	D	19	170	147	121
	D	17	181	157	138
	S	14	(?)	146	123
	D	12	170	144	119
	S	10	188	143	113
	S	8	178	134	112
16	F	36	197	161	146
	M	34	182	153	123
	S	10	181	147	120
	S	8	167	149	108
	D	6	178	143	98
17	F	38	180	145	128
	M	37	181	145	122
	D	12	165	136	106
	S	10	182	149	120
	S	9	175	140	102
	D	6	170	137	110
	D	4	177	142	103
18	F	40	200	161	132
	M	36	180	147	126
	S	13	181	159	132
	D	10	178	141	108
19	F	65	187	155	133
	M	58	183	152	128
	D	33	189	152	138
	S	30	190	158	134
	S	26	188	159	130
	S	19	181	152	126
	S	17	185	151	122
20	F	56	191	149	135
	M	40	179	154	130
	S	17	182	157	132
	D	16	174	143	118
	S	13	172	—	122
21	F	32	196	153	143
	M	30	181	155	143
	S	8	172	146	120
	S	4	173	141	114
22	F	38	181	150	136
	M	37	185	148	126
	S	14	175	148	119
	D	8	173	144	112
	S	4	168	141	113
23	F	33	192	153	139
	M	32	178	149	128
	D	7	178	147	115
	S	5	169	142	114
	D	3	174	140	—
24	F	30	181	142	138
	M	28	192	161	137
	D	3	151	120	101
	D	1	153	121	91
25	F	53	205	153	141
	M	36	182	151	142
	S	11	184	148	121
	S	10	189	144	118
	S[2]	7	174	150	118
	S[2]	7	176	147	119
	S	3	171	148	121
26	F	37	177	144	122
	M	40	177	152	128
	S	13	179	141	118
	S	11	182	144	121
	S	8	178	148	116
	D	6	174	142	115
27	F	34	184	153	131
	M	33	188	151	138
	S	12	179	148	123
	S	9	181	138	116
	D	7	172	138	106
	D	3	171	141	—
28	F	30	193	149	120
	M	28	186	150	—
	S	13	182	146	107
	S	11	179	142	98
	S	10	175	139	95

[1] *F* = Father. *M* = Mother. *S* = Son. *D* = Daughter. *L* = Length of Head. *W* = Width of Head. *F* = Width of Face. [2] Twins.

I—*Continued*

		Age	L	W	F
29	F	37	192	151	137
	M	31	179	145	128
	D	12	178	141	161
	S	9	181	146	115
	D	8	161	136	110
	S	5	172	148	118
30	F	50	194	142	121
	M	36	179	139	118
	S	18	186	140	115
	S	14	182	139	119
31	F	35	188	153	139
	M	30	180	144	130
	D	5	172	141	115
	D	3	160	133	107
32	F	54	192	157	138
	M	36	176	145	129
	S	8	174	142	117
	D	7	164	139	114
33	F	60	196	158	136
	M	38	177	145	123
	D	12	181	151	121
	S	9	183	148	115
34	F	29	189	153	141
	M	30	187	156	131
	S	6	179	151	130
35	F	40	176	144	129
	M	45	184	155	136
	S	17	185	158	144
	S	10	178	157	132
36	F	45	188	162	130
	M	38	170	153	123
	S	6	160	134	117
	D	4	158	138	97
	D	3	161	132	105
	S	1	159	130	98
37	F	38	183	155	120
	M	32	171	149	102
	D	9	169	143	119
	D	6	165	143	115
	S	4	166	143	118
38	F	36	184	163	141
	M	40	181	154	131
	S	10	171	148	119
	S	7	166	142	114
	D	5	173	142	115
39	F	32	191	159	134
	M	30	190	159	129
	S	5	176	152	116
	D	2	161	137	106
40	F	29	181	153	139
	M	29	175	145	133
	S	7	170	141	112
	D	5	168	142	104
	S	3	169	141	96
41	F	40	187	155	130
	M	32	185	151	134
	S	16	186	153	134
	S	11	176	140	118
	D	7	169	139	104
	S	2	163	134	98
42	F	39	184	152	137
	M	36	180	142	131
	S	14	183	149	122
	S	12	184	154	124
	D	9	163	140	103
	D	7	175	141	105
	D	4	173	140	99
	S	2	172	143	—
43	F	34	196	150	132
	M	33	186	144	122
	D	12	177	139	106
	S	10	176	136	99
	S	6	168	135	101
	D	3	161	125	97
44	F	46	197	163	140
	M	41	179	149	124
	D	19	181	148	125
	S	13	183	150	122
	D	11	177	143	—
	D	7	169	138	—
	S	2	151	130	—
45	F	25	189	157	136
	M	24	179	158	138
	S	6	174	151	118
	D	4	139	124	—
46	F	48	196	154	144
	M	34	174	144	128
	S	16	182	142	142
	S	14	179	147	121
	D	10	171	148	99
	S	8	165	141	97
47	F	37	187	158	128
	M	39	181	154	133
	D	13	176	151	115
	D	11	175	149	101
	S	7	169	141	92
48	F	73	188	145	139
	M	69	182	147	133
	S	35	192	156	141
	S	32	182	146	137
	D	25	184	153	134
	S	21	185	149	140

II

		Age	L	W
49	F	40	190	153
	M	40	190	151
	S	19	191	157
	D	18	192	151
	D	16	189	154
	D	12	183	150
	D	8	180	145
	D	6	176	146
	S	4	178	145
50	F	55	186	152
	M	40	183	152
	S	21	181	159
	S	19	192	160
	S	16	180	150
	D	13	173	148
	S	12	178	150
	S	9	180	145
	S	6	165	145
	S	2	165	138
51	F	48	190	150
	M	40	171	140
	D	20	176	147
	D	14	177	147
	S	12	177	149
	S	8	169	141
52	F	—	180	152
	M	—	176	148
	S	11	163	137
	S	9	167	145
	S	8	171	145
	S	7	175	152
53	F	37	186	151
	M	36	186	154
	S	15	171	138
	S	7	167	140
54	F	45	186	150
	M	42	180	156
	D	18	178	146
	S	16	182	151
	D	13	177	138
	D	11	174	145

II—*Continued*

		Age	L	W
	S	10	180	147
	D	9	170	145
	D	6	165	138
55	F	34	190	161
	M	30	186	145
	S	15	187	153
	D	10	176	145
	D	8	180	143
	D	6	175	139
	D	3	170	130
	S	1	161	129
56	F	52	188	157
	M	49	181	155
	S	19	186	160
	S	15	176	155
	D	12	179	152
	D	9	166	146
57	F	52	182	153
	M	49	187	159
	D	16	174	156
	S	13	178	158
	S	11	173	157
	D	6	158	145
58	F	50	200	153
	M	49	180	154
	D	24	190	155
	S	20	195	164
	D	12	184	151
59	F	35	193	165
	M	28	181	146
	D	9	175	147
	D	8	172	141
60	F	32	185	156
	M	26	174	138
	D	7	160	140
	S[1]	4	166	136
	S[1]	4	175	148
61	F	45	187	155
	M	42	190	157
	D	20	183	157
	D	16	180	154
	S	10	183	151
	S	8	181	149
	D	4	169	155
62	F	32	190	160
	M	29	193	153
	D	5	172	141
	S	3	171	139
63	F	27	195	165
	M	28	180	141
	S	5	174	140
64	F	31	186	158
	M	27	175	146
	D	7	170	151
	S	4	170	150
65	F	25	182	151
	M	20	172	145
	S	6	170	141
66	F	27	189	159
	M	25	174	140
	S	5	169	140
	S	3	156	134
67	F	39	180	145
	M	41	185	154
	S	11	181	148
	D	7	172	146
	D	5	165	140
68	F	27	195	160
	M	25	182	150
	S	5	170	146
	S	3	170	142
69	F	24	194	158
	M	22	192	156
	D	6	168	145
	D	4	161	145
	D	2	160	142
70	F	43	181	154
	M	38	172	155
	D	6	168	135
	D	3	162	130
71	F	40	190	152
	M	38	184	161
	D	12	175	145
	D	11	170	135
	D	9	172	148
	S	5	175	145
72	F	40	203	160
	M	40	186	143
	S	21	198	155
	D	18	190	145
	D	15	185	153
	D	13	190	151
	S	12	181	146
	D	10	184	148
	D	7	178	146
	D	4	169	137
73	F	31	188	148
	M	30	185	147
	S	11	177	143
	S	2	175	134
74	F	27	188	154
	M	26	175	146
	S	5	167	147
75	F	25	191	149
	M	28	186	152
	S	2	160	140
76	F	35	193	165
	M	34	188	148
	S	14	190	162
	S	12	185	153
	S	7	165	147
	D	2	168	140
77	F	40	189	150
	M	36	180	140
	D[1]	15	165	140
	S[1]	15	173	144
	S	12	175	142
	S	9	165	143
78	F	34	184	145
	M	26	175	145
	S	5	156	130
	S	3	164	134
79	F	38	188	154
	M	36	181	141
	S	19	186	151
	D	14	175	138
	D	13	180	146
	S	11	170	142
	D	8	163	138
	D	6	165	141
	S	4	167	138
80	F	33	179	155
	M	30	187	147
	S	10	177	141
	D	8	170	142
	S	8	171	141
	S	3	162	140
81	F	37	201	160
	M	36	190	160
	S	13	185	161
	D	8	182	154
	S	6	178	150
	D	2	173	140
82	F	42	185	153
	M	33	187	160
	S	7	190	152
	D	6	165	141
	D	2	171	140
83	F	27	182	153
	M[2]	25	185	146
	D	2	155	131
	S	1	155	127

[1] Twins.

[2] Eldest daughter of 84 M.

II — *Continued*

		Age	L	W
84	F	40	200	160
	M[1]	38	179	150
	D[2]	25	185	146
	D	19	190	145
	D	18	181	140
	S	14	178	138
	S	11	180	140
	D	11	175	139
	D	7	178	138
	S	5	169	132
85	[3]	64	192	156
	F	38	190	153
	M	35	187	153
	D	17	181	145
	D	14	180	150
	D	10	178	146
	D	9	175	140
	S	7	175	146
	D	5	161	137
86	F	30	183	152
	M	27	191	147
	D	7	178	138
	D	6	182	141
	S	3	162	129
87	F	38	180	157
	M	31	186	146
	S	13	176	144
	D	7	163	140
	D	6	157	140
	S	4	170	140
	S	2	159	136
88	F	28	182	151
	M	25	191	145
	S	7	162	151
89	F	35	193	160
	M	28	183	155
	D	6	167	151
	D	4	165	140
90	F	35	190	157
	M	29	170	142
	D	8	172	140
	S	6	169	144
	S	5	165	142
91	F	36	182	157
	M	30	190	155
	S	9	171	147
	D	8	171	145
	D	6	171	143
	S	2	165	145
92	F	37	199	166
	M	28	180	153
	D	6	170	147
	D	4	170	137
93	F	34	188	155
	M	35	174	152
	D	14	174	145
	D	11	184	146
	S	6	175	148
94	F	40	182	155
	M	37	182	145
	D	14	185	146
	D	12	170	146
	D	11	173	143
95	F	37	190	160
	M	26	190	155
	S	4	170	146
96	F	33	182	152
	M	29	176	145
	D	8	170	134
	S	4	166	139
	S	2	177	156
97	F	32	196	160
	M	29	180	155
	S	6	172	140
	S	3	168	139
98	F	38	197	156
	M	36	191	146
	D	8	182	148
	D	7	176	140
	S	3	183	141
99	F	30	191	159
	M	28	170	146
	D	10	178	145
	S	6	165	148
100	F	31	200	160
	M	26	177	145
	S	5	179	152
	D	4	169	140
101	F	50	184	148
	M	48	175	147
	D	17	182	148
	D	13	178	150
	D	9	175	141
102	F	29	187	151
	M	25	188	157
	S	4	177	141
103	F	40	188	153
	M	38	185	148
	S	13	183	147
	D	8	170	143
104	F	42	185	159
	M	38	185	150
	S	14	183	164
	S	12	172	151
	D	10	164	148
	D	6	168	151
	D	5	166	142
105	F	25	186	150
	M	23	188	145
	S	4	170	142
	D	2	160	135
106	F	42	188	150
	M	32	187	155
	D	16	175	150
	D	14	177	153
	S	12	182	153
	D	7	168	142
107	F	49	190	158
	M	47	182	150
	?	17	178	148
	S	16	180	153
	S	13	182	156
	D	7	164	136
108	F	33	182	150
	M	30	181	151
	S	7	174	148
	D	4	166	140
	D	2	152	130
109	F	50	193	161
	M	46	189	154
	D	17	181	156
	D	16	177	153
	S	10	178	150
	D	6	182	150
110	F	40	202	156
	M	39	180	152
	S	12	180	149
	D	10	177	150
	D	8	168	145
	D	6	165	143
	S	4	173	150
	D	2	160	130
111	F	39	190	158
	M	38	180	147
	S	20	187	150
	D	11	172	145
	S	9	180	151
	S	6	175	148
	D	5	175	151
112	F	37	193	150
	M	35	183	147

[1] Mother of 83 M. The ages in this family are improbable. [2] Same as 83 M.
[3] Mother's father.

II—*Continued*

		Age	L	W
	S	5	173	140
	D	3	169	136
113	F	58	190	156
	M	55	190	158
	D	21	180	147
	D	18	185	148
	S	17	200	160
114	F	55	189	153
	M	50	181	142
	S	23	187	146
115	F	55	193	160
	M	40	180	155
	S	13	176	149

		Age	L	W
	D	10	172	145
	D	6	171	140
	S	3	166	144
116	F	32	186	155
	M	28	174	155
	S	5	170	147
	S	3	168	142
117	F	40	196	155
	M	40	192	150
	D	12	186	149
	D	10	180	148
	S	6	185	148
118	F	67	183	155

		Age	L	W
	M	50	185	150
	S	12	183	150
	D	6	167	145
119	F	40	199	161
	M	38	185	146
	S	13	185	155
	S	11	176	148
	D	3	170	144
	D	3	165	138
120	F	28	193	156
	M	28	178	158
	S	6	176	148
	S	4	173	141
	S	2	175	147

III

		Age	L	W
121	F	38	185	161
	M	35	174	155
	D	11	171	145
	S	8	174	155
	D	5	163	141
	D	3	160	140
	S	2	160	135
122	F	29	193	155
	M	32	186	155
	S	9	175	146
	S	8	175	150
	S	5	178	150
123	F	38	190	164
	M	35	179	148
	D	16	173	155
	S	13	172	150
	S	11	170	143
	S	4	172	145
124	F	50	197	162
	M	45	200	155
	D	18	185	157
	S	15	192	155
	D	13	196	155
	D	10	181	140
125	F	45	188	153
	M	40	176	146
	D	12	179	145
	S	11	177	145
	S	8	176	146
	S	6	174	144
126	F	57	195	160
	M	56	180	145
	D	20	180	145
	D	18	180	148
	D	16	179	148

		Age	L	W
	S	15	185	157
	D	10	174	145
	S	7	165	143
	S	5	178	146
127	F	40	195	155
	M	38	180	152
	S	16	185	157
	D	7	170	143
128	F	36	182	155
	M	31	180	148
	S	12	165	137
	D	10	165	140
	S	8	173	155
129	F	48	188	155
	M	44	176	156
	S	20	180	151
	D	14	175	146
	D	11	175	145
	S	9	175	143
130	F	46	191	150
	M	44	184	150
	S	26	196	152
	S	23	188	151
	D	18	180	148
	S	16	181	149
	D	12	176	148
	D	8	179	146
131	F	28	198	149
	M	26	183	153
	S	6	177	143
	D	4	174	148
132	F	42	183	152
	M	40	180	156
	D	18	182	151

		Age	L	W
	S	19	188	159
	S	12	181	155
	D	8	179	149
133	F	26	186	151
	M	21	177	143
	D	3	175	139
134	F	45	186	152
	M	34	182	150
	D	15	181	149
	D	12	181	150
	D	10	178	143
	S	6	171	140
135	F	48	181	148
	M	41	185	144
	S	20	186	158
	S	17	189	158
	D	14	174	137
	D	12	189	149
136	F	34	172	154
	M	25	181	147
	D	6	166	139
	S	4	161	145
137	F	72	195	144
	M	68	179	152
	D	38	181	145
137*	M	Same as 137 D.		
	S	17	190	150
	D	14	174	145
	S	12	171	147
138	F	38	188	155
	M	33	180	148
	S	13	181	141
	S	10	180	145
	S	7	165	144

III — *Continued*

		Age	L	W
139	F	64	186	149
	M	54	184	155
	S	36	181	147
	S	32	188	144
	D	30	183	153
	S	28	183	151
	S	21	182	154
140	F	36	185	161
	M	36	187	150
	D	14	182	145
	S	11	175	151
	S	7	164	140
	S	3	167	133
141	F	28	182	155
	M	26	176	141
	D	6	161	140
	D	4	161	138
	S	2	162	135
142	F	34	185	160
	M	26	180	151
	S	7	168	135
	D	4	168	145
143	F	48	187	156
	M	42	184	148
	S	21	188	154
	S	18	194	158
	S	16	191	149
144	F	35	186	153
	M	33	185	150
	S	11	177	141
	D	9	174	139
	D	5	166	134
145	F	28	178	158
	M	24	175	151
	D	3	155	138
146	F	40	193	154
	M	35	185	156
	D	13	182	152
	D	9	172	145
	S	7	177	150
147	F	30	192	155
	M	28	183	156
	D	8	169	146
	D	4	166	145
148	F	31	196	151
	M	30	183	157
	S	11	183	151
	D	6	168	147
149	F	36	190	146
	M	34	181	147
	D	13	166	140
	S	9	175	145
	S	6	170	146
150	F	36	187	154
	M	30	179	151
	S	12	175	153
	S	7	168	146
	D	9	167	143
151	F	28	190	159
	M	23	180	150
	S	3	158	145
152	M	60	187	150
	D[1]	23	185	145
	D[1]	23	185	147
	S	18	191	158
	S	16	193	153
152*	F	27	192	160
	M	Same as 2d D of last family		
	S	3	181	140
153	F	36	185	155
	M	26	187	160
	D	9	166	151
	S	7	175	146
	D	3	166	140
154	F	53	185	153
	M	50	182	152
	S	24	186	156
	S	22	182	149
155	F	46	200	155
	M	36	180	157
	S	17	202	150
	S	15	185	142
	D	9	174	146
156	F	25	195	161
	M	26	184	153
	D	4	176	145
	D	2	166	145
157	F	42	182	160
	M	40	182	165
	S	24	184	168
	D	22	176	152
	D	15	170	156
	S	13	174	152
	D	10	171	153
	D	10	160	145
158	F	31	196	151
	M	30	186	157
	D	6	166	147
	D	4	166	147
	S	2	156	149
159	F	—	185	162
	M	34	176	144
	S	14	178	143
	D	12	172	144
	D	9	167	145
	S	7	166	144
	S	5	161	141
	D	2	164	130
160	F	49	188	147
	M	46	191	151
	S	24	195	150
	S	21	192	152
	D	18	182	146
	S	16	185	152
	D	14	180	144
	D	9	178	148
	D	5	176	141
161	F	50	186	153
	M	50	176	145
	D	17	176	143
	S	16	186	152
	S	10	169	150
162	F	34	188	163
	M	33	179	152
	S	5	163	144
	D	2	153	142
163	F	65	186	156
	M	55	184	153
	S	33	192	158
	D	31	179	153
	D	24	175	151
	S	22	181	154
	S	19	186	151
164	M	68	192	155
	D	40	180	151
164*	F	45	192	150
	M	Same as 164 D		
	S	20	195	162
	D	16	180	149
	S	10	186	150
165	F	28	182	148
	M	21	178	150
	D	5	158	133
	D	3	155	136
166	F	32	200	159
	M	28	179	152
	D	10	177	146
	D	9	174	150
167	F	33	190	160
	M	27	181	147
	D	7	177	145
	S	5	176	145

[1] Twins.

III — *Continued*

		Age	L	W
168	F	56	184	151
	M	45	182	155
	S	28	177	158
	D	22	178	146
	S	19	183	161
169	F	45	191	157
	M	43	181	151
	D	17	182	151
	S	14	185	147
	S	8	175	144
	D	5	168	141
170	F	32	202	165
	M	26	174	151
	S	7	171	150
	D	5	172	150
171	F	37	188	150
	M	35	183	145
	D	3	177	141
172	F	40	200	148
	M	35	174	144
	D	15	172	154
	S	13	182	150
	S	11	172	155
	D	7	165	145
173	F	21	184	162
	M	23	186	152
	S	4	162	145
174	F	23	191	157
	M	20	181	148
	D	2	166	126
175	F	40	187	159
	M	38	180	153
	S	15	186	148
	S	13	186	146
	S	11	177	150
	S	8	178	142
176	F	32	196	156
	M	30	173	145
	S	6	164	143
	S	5	164	143
	D	3	159	126
177	F	34	185	154
	M	29	178	146
	S	6	170	145
	D	2	156	128
178	F[1]	32	192	155
	M	30	182	155
	D	8	183	140
	S	5	176	142
	S	3	176	145
179	F[2]	28	185	154
	M	25	180	152
	S	3	169	136
180	F	49	187	160
	M	38	171	149
	D	14	178	151
	S	13	174	150
	D	7	162	140
	D	3	155	133
181	F	48	190	147
	M	42	190	153
	S	17	183	155
	S	15	186	152
	D	13	176	143
	S	10	180	145
	S	8	176	143
182	F	39	200	158
	M	32	182	149
	D	13	184	145
	S	12	182	150
	S	9	186	152
	D	7	171	150
	S	5	177	139
183	F	42	202	159
	M	40	175	140
	D	20	183	156
	S	18	189	157
	D	13	182	155
	S	10	177	151
	S	9	175	152
	D	7	168	146
184	F	50	191	151
	M	46	186	151
	D	25	180	152
	D	20	187	145
	D	18	185	152
	S	17	185	155
185	F	46	187	154
	M	42	177	148
	D	20	175	144
	D	18	175	151
	D	16	171	140
	D	12	165	143
	D	8	160	140
	S	6	165	136
186	F	34	188	155
	M	28	170	140
	D	9	160	142
	D	8	160	142
187	F	55	185	155
	M	50	182	158
	S	19	195	165
	S	14	190	158
	D	12	180	159
	D	8	178	145
188	F	42	199	155
	M	34	179	148
	S	12	178	145
	D	10	175	138
189	F	38	190	157
	M	38	176	148
	S	20	189	148
	D	17	172	142
	S	13	168	143
	S	11	178	150
	S	6	173	143
190	F	34	188	155
	M	28	170	140
	D	9	160	141
	D	8	160	142
191	F	52	186	154
	M	48	175	155
	D	22	175	150
	D	18	180	153
	D	14	183	155
	S	12	182	153

[1] Brother of 179 F.

[2] Brother of 178 F.

COLUMBIA UNIVERSITY,
NEW YORK CITY.